

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
8 February 2001 (08.02.2001)

PCT

(10) International Publication Number  
**WO 01/08874 A1**

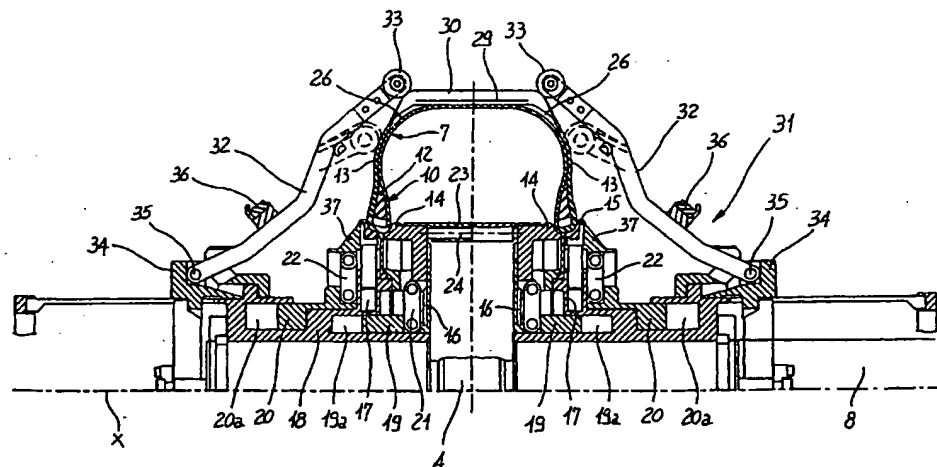
- (51) International Patent Classification: **B29D 30/24**, 30/32
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- (21) International Application Number: **PCT/EP00/05972**
- (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (22) International Filing Date: **27 June 2000 (27.06.2000)**
- (25) Filing Language: **English**
- (26) Publication Language: **English**
- (30) Priority Data:  
99830497.6 30 July 1999 (30.07.1999) EP  
60/155,129 22 September 1999 (22.09.1999) US
- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
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**Published:**

— With international search report.

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: **TYRE ASSEMBLING APPARATUS**



(57) Abstract: A tyre assembling apparatus (2) made up of two halves (3a, 3b) axially movable close to each other, on which a carcass sleeve (7) of cylindrical conformation is fitted. Each half (3a, 3b) comprises radial sectors (5) each provided with a radially expandable holding member (14, 15) to engage the carcass sleeve (7) close to an annular anchoring structure (10). Supporting members (23) associated with the holding members (14, 15) define a cylindrical supporting surface for the carcass plies (9) extended in a cylindrical conformation, thereby making application of under-belt strips (26) easier. Turning-up devices (31) comprising circumferentially distributed levers (32) turn the side edges (7a, 7b) of the carcass sleeve (7) up around the annular anchoring structures (10), after the halves (3a, 3b) have been moved close to each other to give the carcass sleeve (7) a toroidal conformation and engage it to a belt package (29) provided with a tread band (30).

WO 01/08874 A1

## TYRE ASSEMBLING APPARATUS

The present invention relates to a tyre assembling apparatus, comprising:

- 5     - an assembling drum having first and second halves that are axially opposed along a geometric axis of the drum itself, each of said halves comprising a plurality of circumferentially distributed radial sectors;
- 10    - radial-movement devices associated with each of said halves to selectively translate the corresponding sectors between a contracted condition in which they are disposed closer to the geometric axis of the drum and an expanded condition in which they are disposed spaced apart from the geometric axis of the drum;
- 15    - at least one axial-movement actuator to translate said halves relative to each other, between a condition in which they are moved close to each other and a condition in which they are moved apart from each other along the geometric axis of the drum.

20

As far as tyre manufacture for vehicle wheels is concerned, a so-called carcass sleeve is provided to be first made, which carcass sleeve is formed by winding up one or more carcass plies on a cylindrical drum.

25

Fitted on the side edges of the carcass ply or plies disposed in a cylindrical configuration are respective annular anchoring structures, each of them being usually made up of a so-called "bead wire" associated with an elastomer filling and intended for being incorporated into regions usually identified as "beads", formed from a turning-up action carried out on the side edges of the plies around the anchoring structures themselves.

30

Tyre manufacture also involves formation of a so-called belt package comprising one or more belt layers of textile and/or metallic material, with which a tread band is associated, at a radially outer position thereof. The  
5 belt package with the tread band is coaxially disposed around the carcass sleeve, and afterwards the carcass ply or plies are shaped in a toroidal configuration by mutual axial approaching of the tyre beads and simultaneous admission of fluid under pressure to the inside of the  
10 carcass sleeve so as to determine application of the belt package and tread band to the tyre carcass structure at a radially outer position thereof.

Several different apparata have been developed and  
15 proposed for carrying out the above described operations at least partly.

For example, Italian Patent Application No. 25594 A/81 in the name of the same Applicant, describes an apparatus  
20 comprising an assembling drum made up of a plurality of radially expandable sectors to impose such an expansion to the carcass sleeve that engagement of the bead wires against the carcass plies is caused. Each sector has two side portions that are axially movable relative to a  
25 central portion, capable of enabling the cords forming the carcass ply or plies to be conveniently shaped around the radially inner portion of each bead wire. The carcass sleeve thus made lends itself to be transferred to a second assembling drum, where turning up of the side  
30 edges of the carcass plies around the annular anchoring structures will be carried out, as well as application of the belt package with the tread band.

In document US-4,362,592 it is provided that the carcass

sleeve formed on the assembling drum should have its side edges axially projecting in a cantilevered fashion from the drum side edges. In the proximitty of the opposite sides of the drum is a pair of turning-up devices each comprising a plurality of levers circumferentially distributed around the geometric axis of the drum and movable towards the latter to carry out turning-up of the side edges of the carcass sleeve around the anchoring structures to the beads. In particular, the levers of each turning-up device are axially movable towards the drum starting from a rest condition in which they have an orientation converging towards the geometric axis of the drum itself. In a starting step of the movement, spreading apart of the levers is caused by effect of a guide surface of truncated conical form acting on abutment rollers associated with the levers themselves at a median point of their longitudinal extension. In a second step of the displacement, each lever acts by its free end on the side edge of the sleeve causing turning-up of same. The lever action on the side edge takes place through a spring extending according to a closed line passing through the free ends of all levers. A second spring circumscribing the levers in a median plane of the longitudinal extension of same ensures their coming back to the rest position. The sleeve thus made must be transferred to a further apparatus where application of the belt package and the tread band will be carried out.

Italian Patent Application No. 20467 A/82 in the name of the same Applicant herein mentioned as an example of the most pertinent state of the art, contemplates use of an assembling drum comprising first and second halves to be mutually moved close to each other along the geometric

axis of the drum. Each half has respective radially-expandable sectors, each defining a holding member made up of an axially inner portion and an axially outer portion to be moved close to each other in an axial direction to define an engagement seat for the bead wires associated with the carcass sleeve previously formed in another work station.

When engagement has occurred, the first and second halves of the assembling drum are moved close to each other so as to shape the carcass sleeve into a toroidal configuration, concurrently with inflation of air or other fluid thereinto.

In document US-3,887,423 a tyre manufacturing machine is described which has a drum essentially defined by a bladder expandable from a first operating condition, in which it is extended in a substantially cylindrical conformation, to a second operating condition in which it takes a toroidal conformation. A carcass sleeve is fitted on the drum in the first operating condition so that it projects from opposite sides past the drum by its side edges having a slightly smaller diameter than the maximum diameter of the drum itself. Two anchoring structures to the beads are placed on the carcass sleeve close to respective drum shoulders defined at the diametrical narrowing of the side edges of the carcass sleeve.

The side edges of the sleeve are disposed so as to bear on respective elastic tubular membranes within each of which a plurality of circumferentially-distributed levers operates, which levers are axially movable towards the drum to cause turning-up of the respective side edge around the annular anchoring structure, under the action

of pressure rollers acting on the inner face of the membrane.

When turning-up is over, the drum and carcass sleeve take a toroidal conformation and the levers are operated again to determine application of the sidewalls previously laid down on the elastic membranes.

The present invention originates from the Applicant's perception that the present apparatus for tyre assembling and related assembling method could be further improved, in particular in connection with the possibility of applying further components such as inserts of textile, metallic and/or elastomer materials to the region of the carcass sleeve included between the annular anchoring structures, which inserts are intended for interacting with the belt package to be associated with the carcass sleeve.

More specifically, application of said components could be carried out by means of devices such structured that they did not interfere with movement of the different drum parts during the step of shaping the carcass sleeve, thereby bringing about advantages on the quality of the finished product and the machinery productivity.

In more detail, it is an object of the present invention to provide a tyre assembling apparatus, characterized in that each of said sectors comprises: a holding member defining an engagement seat for an annular structure of anchoring to the bead being part of a carcass sleeve fitted on said drum; and a supporting member linked, relative to said holding member, in a position axially internal to the latter and movable between a first

operating condition in which it is axially spaced apart from the holding member to offer a supporting seat to at least one ply being part of said carcass sleeve and a second operating condition in which it is disposed axially close to the holding member to enable mutual approaching of said halves.

In a preferential embodiment of the invention, it is advantageously provided that the supporting member should be slidably engaged along at least one guide rod extending in cantilevered fashion from said holding member.

In more detail, it is conveniently provided for the guide rod to extend in parallel to the geometric axis of the assembling drum. In addition, at least one elastic return member may be advantageously provided to be operatively associated with the supporting member to elastically urge it away from the holding member.

For instance, this elastic return member may comprise at least a return spring associated with said guide rod.

Preferably, the supporting members associated with the first and second halves respectively have abutment surfaces facing each other and spaced apart from each other by a smaller amount than the stroke carried out by said halves between their spaced apart condition and approaching condition.

Under this circumstance, each of said supporting members is susceptible of being translated towards the respective holding member following a thrust action against at least one of the supporting members associated

with the other half during mutual axial approaching of said halves.

- 5      Advantageously, the guide rods of the supporting members associated with the first half are angularly offset relative to the guide rods of the supporting members associated with the second half, so as to avoid mutual interferences between the rods themselves when the first and second halves are moved close to each other.
- 10     In accordance with a further preferential feature of the present invention, the supporting members associated with each of said halves, under a radially-expanded condition define a substantially continuous cylindrical surface.
- 15     For the purpose, it is preferably provided that each of said supporting members should have end slots slidably housing end projections provided on the circumferentially adjoining supporting members.
- 20     In a preferential embodiment, each of said holding members comprises an axially inner portion and an axially outer portion selectively movable, independently of each other, under the action of the radial-movement devices.
- 25     The radial-movement devices preferably comprise, for each of the halves of the assembling drum: a supporting hub coaxial with the geometric axis of the drum, slidably engaging the holding members of the respective sectors in a radial direction to said geometric axis; at least one
- 30     radial-movement actuator operatively in engagement with said supporting hub and axially movable relative thereto; transmission connecting rods each operatively engaged between the radial-movement actuator and the holding



member of one of said sectors to give rise to a radial movement of the holding member following an axial movement transmitted by said radial-movement actuator.

In more detail, said radial-movement devices may be

5 advantageously provided to comprise, for each of the assembling drum halves: a supporting hub coaxial with the geometric axis of the drum; first guide elements for slidably engaging the axially inner portions of the holding members with the supporting hub, in a radial  
10 direction to said geometrical axis; at least one first radial-movement actuator operatively in engagement with said supporting hub and axially movable relative thereto; first transmission connecting rods each operatively engaged between the first radial-movement actuator and  
15 one of said axially inner portions to give rise to a radial movement of said one radially inner portion following an axial movement transmitted by said first radial-movement actuator; second guide elements for slidable engagement of the axially outer portions of the holding members with the supporting hub, in a radial  
20 direction to said geometric axis; at least one second radial-movement actuator operatively in engagement with said supporting hub and axially movable relative thereto; second transmission connecting rods each operatively  
25 engaged between the second radial-movement actuator and one of said axially outer portions to give rise to a radial movement of said one axially outer portion following an axial movement transmitted by said second radial-movement actuator.

30

It may be also advantageously provided that in the radial sectors of each of said first and second halves, powered axially inner portion operated by said radial-movement

devices and driven axially inner portions dragged along in the radial movement of the powered axially inner portions, should be identified.

5 In accordance with a further aspect of the present invention, at least a turning-up device is advantageously provided to be associated with each of said first and second halves, to turn up a side edge of the carcass sleeve around the respective annular anchoring structure.  
10 Advantageously, each turning-up device comprises: a plurality of turning-up levers circumferentially distributed around the geometric axis of the drum, each carrying a pressure element facing the drum; at least one driving member rotatably engaging each of said turning-up  
15 levers at a point spaced apart from said pressure element; operation devices to axially translate the driving member between a rest position in which it is axially spaced apart from the radial sectors of the drum and a work position in which it is disposed close to said  
20 radial sectors.

In a preferential embodiment, the hinging point of each of said turning-up levers on the driving member has, relative to the geometric axis of the drum, a radial  
25 distance smaller than the radial distance measurable on the corresponding pressure element when the driving member is in its rest position.

In addition, the holding member of each sector is  
30 advantageously provided to have, at an axially outer position relative to the drum, a lead-in surface converging towards the geometric axis of the drum and facing the pressure element carried by at least one of

said turning-up levers.

Preferably, each turning-up device further comprises at least one elastic element extending around the geometric axis of the drum and operating on said turning-up levers to transmit to the latter a radial-thrust action towards the geometric axis of the drum itself.

Further features and advantages will become more apparent from the detailed description of a preferred but non-exclusive embodiment of a tyre assembling apparatus in accordance with the present invention. This description will be taken hereinafter with reference to the accompanying drawings, given by way of non-limiting example, in which:

- Fig. 1 is an axial half section of the apparatus of the present invention, under rest conditions;
- Fig. 2 shows the apparatus of Fig. 1 in an operating condition in which a carcass sleeve has been coaxially fitted onto the assembling drum;
- Fig. 3 is a partial section of the apparatus in an operating condition in which the axially inner portions of the holding members being part of the drum sectors have been radially spaced apart to engage the carcass sleeve;
- Fig. 4 shows the apparatus in a step subsequent to Fig. 3, in which engagement of the carcass sleeve has been completed, following the radial expansion of the axially outer portions of the drum sectors, and lying down of under-belt strips onto the carcass sleeve has been carried out;
- Fig. 5 shows a further operating step in which the carcass sleeve has taken a toroidal conformation,

following mutual approach of the anchoring structures to the beads, and coupling between a belt package with a tread band on the carcass sleeve has been carried out;

5 - Fig. 6 shows an operating step in which turning-up of the sidewalls and side edges of the carcass sleeve around the annular anchoring structures to the beads is being carried out;

10 - Fig. 7 shows, in a partly interrupted diametrical section, the axially inner portions of the holding members of the sectors of one of the drum portions, under a retracted condition;

- Fig. 8 shows the axially inner portions of the holding members in an expanded condition;

15 - Fig. 9 shows in an axial section, the supporting portions associated with the radial sectors of the drum, the drum halves being spaced apart from each other;

- Fig. 10 shows the supporting portions of Fig. 8 with the drum halves in a mutual-approaching condition;

20 - Fig. 11 is an elevational partial view showing the mutual engagement between circumferentially contiguous supporting members being part of the radial sectors of the assembling drum.

25 With reference to the cited drawings, a tyre assembling apparatus in accordance with the present invention has been generally identified by reference sign 1.

30 Apparatus 1 comprises an assembling drum 2 having first and second halves 3a, 3b axially opposed along a geometric axis X of the drum itself and susceptible of simultaneous translation, along geometric axis X, between a mutually spaced apart condition, shown in Figs. 1 and 2 for example, and a mutually approached condition, shown

in Figs. 5 and 6 for example, upon command of at least one axial-movement actuator 4.

Each of halves 3a, 3b comprises a plurality of radial sectors 5 circumferentially distributed around geometric axis X and susceptible of translation, upon command of radial-movement devices generally denoted by reference sign 6, between a contracted condition in which, as shown in Fig. 1, they are approached to geometric axis X and an expanded condition in which, as shown in Fig. 4 for example, they are radially spaced apart from the geometric axis itself.

Assembling drum 2 is adapted to receive a carcass sleeve 7 previously formed in a cylindrical conformation during a preceding working step. This carcass sleeve 7 may for example comprise one or more carcass plies 9 disposed in a cylindrical conformation, and a pair of anchoring structures to beads 10 each essentially comprising at least one so-called bead wire 11 provided with an elastomer filling 12 at a radially outer position relative to said bead wire 11.

Additional components may be previously applied to the inner surface of carcass ply or plies 9, which components may be for example at least one layer of raw elastomer material, adapted to form a so-called "liner" for example, and extending until close to annular anchoring structures 10, a pair of strips of elastomer material adapted to constitute tyre side walls 13, applied to respective side edges 7a, 7b of sleeve 7, as well as possible textile or metallic reinforcing strips placed at the overlapping region between the liner and each of the above-mentioned side walls.

As shown in Fig. 2, carcass sleeve 7, engaged on the outer surface of a first transfer ring (not shown), technically defined as first-step transfer, can be coaxially fitted on assembling drum 2, supported in cantilevered fashion at a central shaft 8 and such arranged that halves 3a and 3b are mutually spaced apart and radial sectors 5 are in the contracted condition, as shown in Fig. 1.

Once positioning of carcass sleeve 7 on assembling drum 2 has been carried out, radial sectors 5 of the latter are brought to the expanded condition to firmly hold the sleeve itself close to annular anchoring structures 10 (Fig. 3).

In more detail, for the purpose it is provided for each radial sector 5 to have a holding member 14, 15 (Fig. 2) defining a seat for engagement of sleeve 7 close to one of annular anchoring structures 10. This holding member 14, 15 preferably comprises an axially inner portion 14 and an axially outer portion 15, selectively movable, independently of each other, under the action of radial-movement devices 6.

For this purpose, radial-movement devices 6 advantageously comprise first and second guide elements 16, 17 (Fig. 2) by means of which axially inner portion 14 and axially outer portion 15 are slidably in engagement, in a direction radial to geometric axis X, with a supporting hub 18 coaxial with the geometric axis itself. Operatively engaged in supporting hub 18 are at least a first and a second radial-movement actuators 19, 20 (Fig. 2), of annular conformation for example, axially movable relative to the hub itself, under the action of

a working fluid admitted to respective annular chambers 19a, 20a.

Also provided are first transmission connecting rods 21  
5 each engaged between first radial-movement actuator 19  
and one of axially inner portions 14, as well as second  
transmission connecting rods 22 each engaged between  
second radial-movement actuator 20 and one of axially  
outer portions 15. Each of first and second transmission  
10 connecting rods 21, 22 lends itself to cause a radial  
movement of respective axially inner 14 or outer 15  
portions, following an axial movement transmitted by  
first and second radial movement actuators 19, 20,  
respectively.

15 It may be advantageously provided that in the plurality  
of axially inner portions 14 of radial sectors 5  
belonging to each of halves 3a and 3b of drum 2, powered  
axially inner portions and driven axially inner portions  
following each other in an alternated sequence along the  
20 circumferential extension of the drum itself should be  
identified. Said powered and driven axially inner  
portions have been denoted by 14a and 14b respectively in  
Figs. 1, 7 and 8. As shown in Fig. 1, powered axially  
inner portions 14a are directly submitted to the action  
25 of radial movement devices 6, by means of respective  
first transmission connecting rods 21, whereas driven  
axially inner portions 14b are dragged along in the  
radial movement imposed to operated axially inner  
portions 14a. The dragging action preferably takes place  
30 by means of mutually mating sliding surfaces respectively  
associated with powered 14a and driven 14b axially inner  
portions, as clearly shown in Figs. 7 and 8.

The operating sequence for engaging sleeve 2 by means of holding members 14, 15 first contemplates operation of first radial-movement actuators 19 to cause radial expansion of axially inner portions 14 of each sector 5. Under this situation, as shown in Fig. 3, radially inner portions 14 engage carcass sleeve 7 close to the axially inner regions of annular anchoring structures 10. It may be provided that the radial expansion of radially inner portions 14 should be followed by a slight mutual moving apart of halves 3, under the action of axial-movement actuator 4, to cause an appropriate tensioning of carcass plies 9 at the section included between annular anchoring structures 10. Next second radial-movement actuators 20 are operated to cause the radial expansion of axially outer portions 15, thereby completing engagement of carcass sleeve 7 by radial sectors 5 close to both annular anchoring structures 10 as shown in Fig. 4. Advantageously, respective supporting members 23 are associated with radial sectors 5, said supporting members being placed at an axially inner position relative to respective holding members 14, 15. These supporting members 23 lend themselves to define, when sectors 5 are in a radial-expansion condition, at least one substantially continuous cylindrical surface so as to provide a supporting seat for carcass ply or plies 9 at the regions included between annular anchoring structures 10.

In more detail, each supporting member 23 is operatively connected to holding member 14, 15 of respective sector 5, and is movable between a first operating condition in which, as shown in Figs. 1 to 4, it is axially spaced apart from the holding member itself to provide a



supporting seat for carcass ply 9, and a second operating condition in which, as shown in Figs. 5 and 6, it is axially approached to holding member 14, 15 to enable mutual approaching of halves 3a and 3b of drum 2.

5 Preferably, supporting member 23 is slidably engaged along at least one guide rod 24 extending in cantilevered fashion from respective holding member 14, 15, parallelly of geometric axis X of assembling drum 2.

10 Associated with supporting member 23 is one or more elastic return elements constantly urging member 23 to a condition spaced apart from respective holding member 14, 15. In detail, in the example shown a return spring 25 (only partly illustrated) is provided for the purpose,

15 which spring is coaxially disposed on guide rod 24. The support provided to carcass ply or plies 9 by supporting elements 23 makes it advantageously possible to apply to the region included between annular anchoring structures 10 of carcass sleeve 7, extended in a

20 cylindrical conformation, one or more additional elements to be integrated into the tyre structure. These additional elements may comprise filling and/or reinforcing ribbon-like elements 26, the so-called "under-belt strips" for example (Fig. 4), intended for

25 being incorporated under the side edges of a belt package, close to the tyre shoulders. In particular, it is possible to carry out application of these ribbon-like elements by a winding action and a simultaneous rolling action around geometric axis X of drum 2, while the

30 latter is being driven in rotation, without the risk that stresses and/or anomalous deformations be produced on the carcass plies.

In order to provide carcass ply or plies 9 with a supporting surface as much as possible continuous and homogeneous, each of supporting members 23 is advantageously provided with end slots 27 which slidably house end projections 28, mating with said slots and provided on circumferentially contiguous supporting members 23, as clearly shown in Fig. 11.

When application of ribbon-like elements 26 has been completed, assembling drum 2 is moved to a different working station for shaping and completing the tyre carcass structure. During said displacement the toroidal conformation of carcass sleeve 7 begins by mutual approaching of halves 3a and 3b, concurrently with air or other working fluid admission to the inside of carcass sleeve 7, in such a manner that said sleeve takes a toroidal conformation of increasingly growing diameter. Once the sleeve has been positioned in said working station, it receives a so-called belt package 29 coupled with a tread band 30 disposed at a radially outer position of said belt package 29. Belt package 29, comprising one or more belt layers of textile and/or metallic material, and tread band 30 are obtained on a further drum (not shown), in a different station of the manufacturing machine, and positioned on carcass sleeve 7 with the aid of a second transfer ring (not shown) coaxially fitted on the drum. Said further drum and second transfer ring are not described in detail because they are not part of the present invention. Belt package 29 and tread band 30 are positioned at a centered location around carcass sleeve 7 by axial insertion on assembling drum 2 through said second transfer ring provided with grip members acting on the outer surface of

the tread band itself. Conformation goes on until the radially outer surface of the carcass sleeve adheres to the radially inner surface of belt package 29 (as shown in Figs. 5 and 6). At this point the grip members of the second transfer ring are detached from the tread band surface and the transfer ring is moved away.

Supporting members 23, associated with first 3a and second 3b halves respectively, have abutment surfaces 23a facing each other and respectively moved apart from each other by an amount smaller than the stroke carried out by said halves when they translate from their mutually-spaced apart condition to their mutually-approached condition.

Consequently, during translation of halves 3a and 3b towards the mutual-approaching condition, supporting members 23 abut against each other by their respective abutment surfaces 23a. As axial mutual approaching of halves 3a and 3b goes on, each of supporting members 23 moves towards respective holding member 14, 15 and presses spring 25 fitted on guide rod 24, by effect of the thrust action mutually exchanged with one or more of supporting members 23 associated with the other half.

Advantageously, guide rods 24 of supporting members 23 associated with first half 3a are angularly offset relative to guide rods 24 of supporting members 23 associated with the other half 3b. In other words, guide rods 24 of supporting members 23 associated with one and the other halves 3a and 3b respectively, are angularly offset relative to each other around geometric axis X. Thus, any possibility of mutual interference between guide rods 24 when halves 3a and 3b are brought into

mutual-approaching relationship is eliminated.

In accordance with a further aspect of the present invention, advantageously associated with first 3a and second 3b halves are respective turning-up devices 31, under the action of which side edges 7a, 7b of carcass sleeve 7 are turned up around respective annular anchoring structures 10, and more specifically around bead wires 11 of said structures, to complete tyre manufacturing.

Each turning-up device 31 comprises a plurality of turning-up levers 32 circumferentially distributed around geometric axis X of drum 2. In the accompanying drawings, one turning-up lever alone 32 for each of turning-up devices 31 is shown.

Each turning-up lever 32 substantially lies in a diametrical plane containing geometric axis X and carries, at one free end thereof, at least one pressure element 33, comprising a roller for example, which is turned towards the middle plane of drum 2, the rotation axis of said pressure element 33 being disposed parallelly of said middle plane and perpendicular to said diametrical plane. In more detail, each pressure element 33 is positioned close to one of radial sectors 5, at an axially outer position relative to holding member 14, 15 being part of the sector itself.

Each turning-up device 31 further comprises at least one driving member 34 rotatably engaging each of turning-up levers 32 at a second end thereof or at another hinging point 35 spaced apart from pressure element 33. This driving member 34 can be activated by an operation device

comprising a fluid-operated actuator for example, which is coaxially housed in drum 2 and not shown because it can be made in any convenient manner, which actuator causes the driving member to axially translate from a rest position in which, as shown in Figs. 1 to 5, it is spaced apart from radial sectors 5 belonging to the respective half, and a working position in which, as shown in Fig. 6, it is disposed axially close to said radial sectors.

As clearly shown in Fig. 6, following translation of driving members 34 to the working position, turning-up levers 32 progressively slant while rotating around their hinging points 35, and respective pressure elements 33 cause turning-up of side edges 7a, 7b around anchoring structures 10, radially travelling along tyre side walls 13 away from geometric axis X until they reach tread band 30.

The above-described movement takes place against the action of at least one elastic element 36, consisting of an elastomeric ring for example, extending around geometric axis X and operating on turning-up levers 32 to transmit to said levers a radial thrust action towards the geometric axis itself. Due to the presence of this elastic element 36 a homogeneous thrust action of pressure elements 33 against respective tyre side wall 13 is ensured and a simultaneous movement of the levers themselves during both the going stroke and return stroke to the rest position is promoted.

It is advantageously provided that, when the driving member 34 is at its rest position, turning-up levers 32 preferably extend in the form of a broken line

substantially diverging from geometric axis X at radial sectors 5, as shown in Figs. 1 to 5. Hinging point 35 of each of turning-up levers 32 consequently has a radial distance, relative to geometric axis X, which is smaller than the radial distance measured on corresponding pressure element 33.

It is also preferably provided that radial sectors 5, at an axially outer position, should have respective lead-in surfaces 37 converging towards geometric axis X and facing pressure elements 33. In detail, lead-in surfaces 37 are preferably formed on the axially outer positions of holding members 14, 15 being part of respective radial sectors 5.

Orientation of turning-up levers 32, as well as the presence of lead-in surfaces 37 are favourable for reaching an excellent control on turning-up lever 32 movements, above all at the starting instants of translation of driving members 34 from the rest position. In particular, a slight displacement of the driving members from the rest position can be caused before the step of mutual approaching of halves 3a and 3b of drum 2 begins. Under this situation, pressure elements 33 are brought to a radially outer position relative to lead-in surfaces 37, causing an initial turning-up of side edges 7a, 7b around bead wires 11. Thus, there is eliminated the risk that the cords forming carcass ply or plies 9 may be submitted to undesirable displacements and/or anomalous stresses during the mutual approaching of halves 3a and 3b giving rise to the toroidal conformation of sleeve 7.

- The present invention achieves important advantages.  
In fact, the expedients proposed by the invention enable supporting members 23 to be arranged without the risk that the presence of said members may be a hindrance to  
5 a correct movement of each of halves 3a and 3b of drum 2, in particular during the step of mutual approaching of said halves for giving a toroidal conformation to carcass sleeve 7.
- 10 It should be also appreciated that, in spite of the presence of supporting members 23, apparatus 1 has a great structural simplicity, which results in advantages in terms of easy servicing and setting.
- 15 Moreover, the inclined orientation of turning-up levers 32 at their rest position too, in addition to the above-described advantages, enables the axial sizes of apparatus 2 as a whole to be advantageously reduced. It will be also recognized that since the turning-up levers  
20 have the conformation of a broken line, the risk that they may undesirably come into contact with the tyre, above all at the shoulder regions when pressure elements 33 operate on tread band 30, is eliminated,
- 25 In addition, lead-in surfaces 37 promote the starting contact of pressure elements 33 with the carcass side, enabling said elements to slide along said side in a uniform manner and without discontinuity.

C L A I M S

1. A tyre assembling apparatus, comprising:
- 5 - an assembling drum (2) having first (3a) and second (3b) halves that are axially opposed along a geometric axis (X) of the drum itself, each of said halves (3a, 3b) comprising a plurality of circumferentially distributed radial sectors (5);
  - 10 - radial-movement devices (6) associated with each of said halves (3a, 3b) to selectively translate the corresponding sectors (5) between a contracted condition in which they are disposed closer to the geometric axis (X) of the drum (2) and an expanded condition in which they are disposed spaced apart from the geometric axis (X) of the drum (2);
  - 15 - at least one axial-movement actuator (4) to translate said halves (3a, 3b) relative to each other, between a condition in which they are close to each other and a condition in which they are spaced apart from each other along the geometric axis (X) of the drum (2);
  - 20 characterized in that each of said sectors (5) comprises:
    - a holding member (14, 15) defining an engagement seat of an annular anchoring structure to the bead (10) being part of a carcass sleeve (7) fitted on said drum (2); and
    - 25 - a supporting member (23) linked, relative to said holding member (14, 15), in a position axially internal to the latter and movable between a first operating condition in which it is axially spaced apart from the holding member to provide a supporting seat to at least
    - 30 one ply being part of said carcass sleeve (7) and a second operating condition in which it is disposed axially close to the holding member to enable mutual approaching of said halves (3a, 3b).



2. Apparatus as claimed in claim 1, wherein said supporting member (23) is slidably engaged along at least one guide rod (24) extending in cantilevered fashion from said holding member (14, 15).
- 5 3. Apparatus as claimed in claim 2, wherein said guide rod (24) extends in parallel to the geometric axis (X) of the assembling drum (2).
- 10 4. Apparatus as claimed in claim 1, comprising at least one elastic return member (25) operatively associated with the supporting member (23) to elastically urge it away from the holding member (14, 15).
- 15 5. Apparatus as claimed in claim 2, comprising at least one return spring (25) associated with said guide rod (24) to elastically urge the supporting member (23) apart from the holding member (14, 15).
- 20 6. Apparatus as claimed in claim 2, wherein the guide rods (24) of the supporting members (23) associated with the first (3a) and second (3b) halves respectively, are angularly offset relative to each other.
- 25 7. Apparatus as claimed in claim 1, wherein the supporting members (23) associated with the first (3a) and second (3b) halves respectively, have abutment surfaces (23a) facing each other and spaced apart from each other respectively by an amount smaller than the stroke carried out by said halves between their spaced
- 30 apart condition and approaching condition.
8. Apparatus as claimed in claim 1, wherein the supporting members (23) of each of said halves (3a, 3b)

are susceptible of being translated towards the respective holding members (14, 15) following a thrust action against the supporting members (23) associated with the other half during mutual axial approaching of said halves.

9. Apparatus as claimed in claim 1, wherein the supporting members (23) associated with each of said halves (3a, 3b), under a radially-expanded condition define a substantially continuous cylindrical supporting surface.

10. Apparatus as claimed in claim 1, wherein each of said supporting members (23) has end slots (27) slidably housing end projections (28) provided on the circumferentially adjoining supporting members (23).

11. Apparatus as claimed in claim 1, wherein each of said holding members (14, 15) comprises an axially inner portion (14) and an axially outer portion (15) movable selectively and independently of each other under the action of the radial-movement devices (6).

12. Apparatus as claimed in claim 1, wherein said radial-movement devices (6) comprise, for each of the halves (3a, 3b) of the assembling drum (2):

- a supporting hub (18) coaxial with the geometric axis (X) of the drum (2), slidably engaging the holding members (14, 15) of the respective sectors (5) in a radial direction to said geometric axis (X);
- at least one radial-movement actuator (19, 20) operatively in engagement with said supporting hub (18) and axially movable relative thereto;

transmission connecting rods (21, 22) each operatively engaged between the radial-movement actuator (19, 20) and the holding member (14, 15) of one of said radial sectors (5) to give rise to a radial movement of the holding member (14, 15) following an axial movement transmitted by said radial-movement actuator (19, 20).

13. Apparatus as claimed in claim 11, wherein said radial-movement devices (6) comprise, for each of the halves (3a, 3b) of the assembling drum (2):

- a supporting hub (18) coaxial with the geometric axis (X) of the drum (2);
  - first guide elements (16) for slidably engaging the axially inner portions (14) of the holding members (14, 15) with the supporting hub (18), in a radial direction to said geometrical axis (X);
  - at least one first radial-movement actuator (19) operatively in engagement with said supporting hub (18) and axially movable relative thereto;
  - first transmission connecting rods (21), each operatively engaged between the first radial-movement actuator (19) and one of said axially inner portions (14) to give rise to a radial movement of said one radially inner portion following an axial movement transmitted by said first radial-movement actuator (19);
  - second guide elements (17) for slidable engagement of the axially outer portions (15) of the holding members (14, 15) with the supporting hub (18), in a radial direction to said geometric axis (X);
  - at least one second radial-movement actuator (20) operatively in engagement with said supporting hub (18) and axially movable relative thereto;
- second transmission connecting rods (22) each operatively

engaged between the second radial-movement actuator (20) and one of said axially outer portions (15) to give rise to a radial movement of said one axially outer portion following an axial movement transmitted by said second radial-movement actuator (20).

14. Apparatus as claimed in claim 13, wherein in the radial sectors (5) of each of said first (3a) and second (3b) halves, are present axially inner powered portions (14a) operated by said radial-movement devices and driven axially inner portions (14b) dragged along in the radial movement of the powered axially inner portions (14a).

15. Tyre assembling apparatus according to claim 1, wherein at least one turning-up device (31) is associated with each of said first (3a) and second (3b) halves, to turn up a side edge (7a, 7b) of the carcass sleeve (8) around the respective annular anchoring structure (10).

16. Apparatus as claimed in claim 15, wherein each turning-up device (31) comprises:

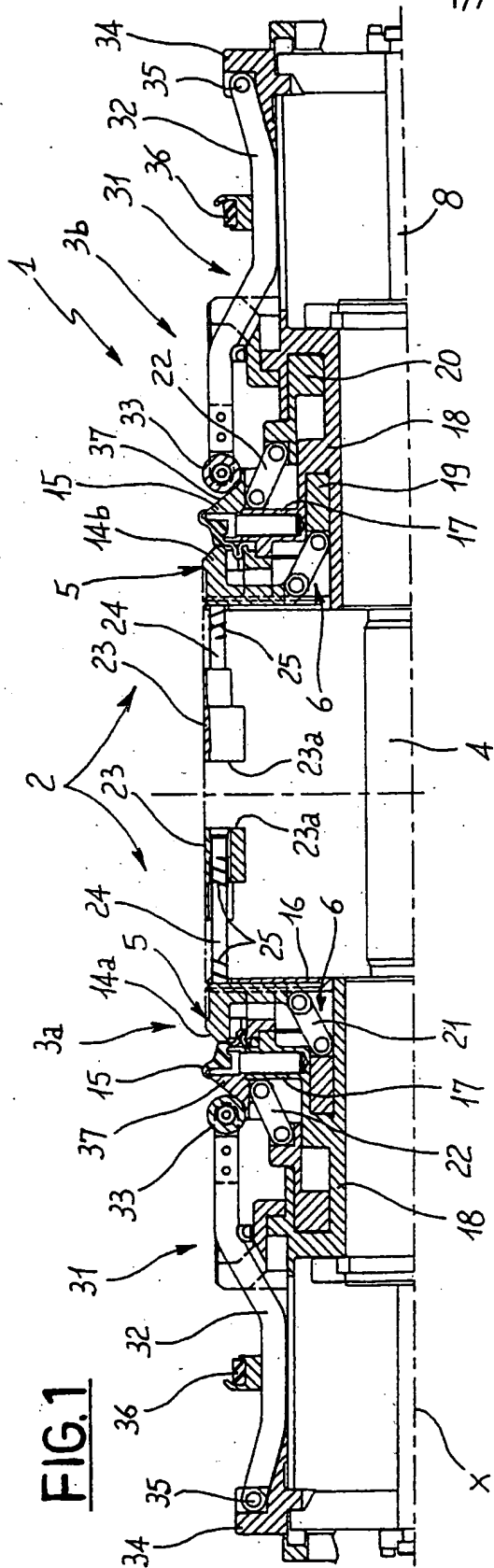
- a plurality of turning-up levers (32) circumferentially distributed around the geometric axis (X) of the drum (2), each carrying a pressure element (33) facing the drum (2);
- at least one driving member (34) rotatably engaging each of said turning-up levers (32) at a hinging point (35) spaced apart from said pressure element (33);
- operation devices to axially translate the driving member (34) between a rest position in which it is axially spaced apart from the radial sectors (5) and a working position in which it is disposed close to said radial sectors.

17. Apparatus as claimed in claim 16, wherein the hinging point (35) of each of said turning-up levers (32) on the driving member (34) has, relative to the geometric axis (X) of the drum (2), a radial distance smaller than the radial distance measurable on the corresponding pressure element (33) when the driving member (34) is in its rest position.

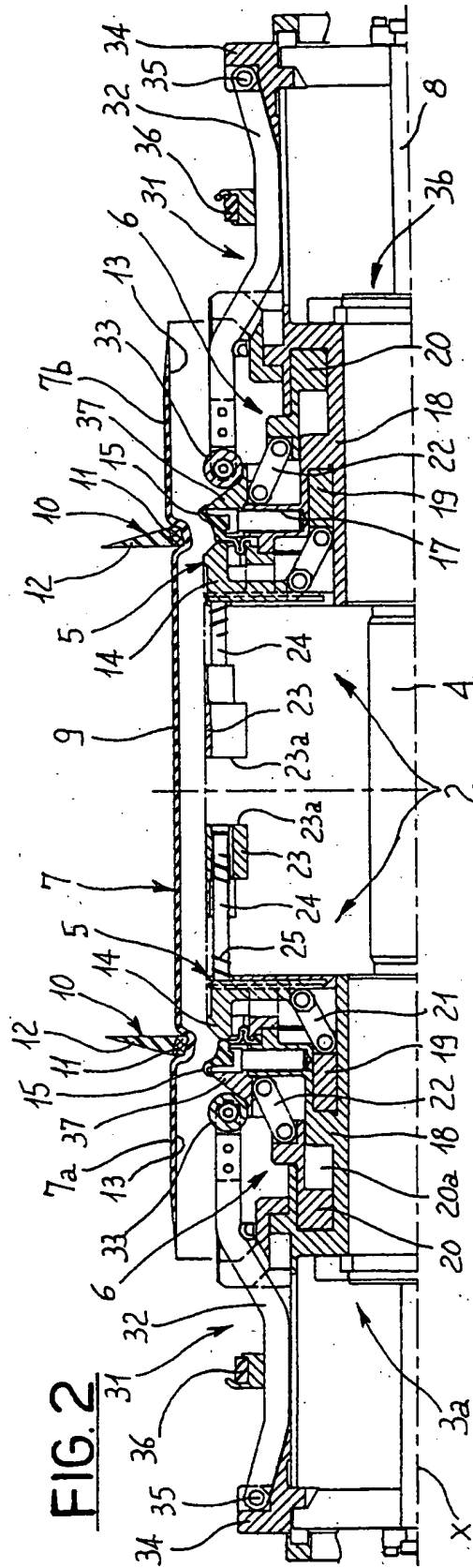
18. Apparatus as claimed in claim 16, wherein the holding member (14, 15) of each radial sector (5) has, at an axially outer position, a lead-in surface (37) converging towards the geometric axis (X) of the drum (2) and facing the pressure element (33) carried by at least one of said turning-up levers (32).

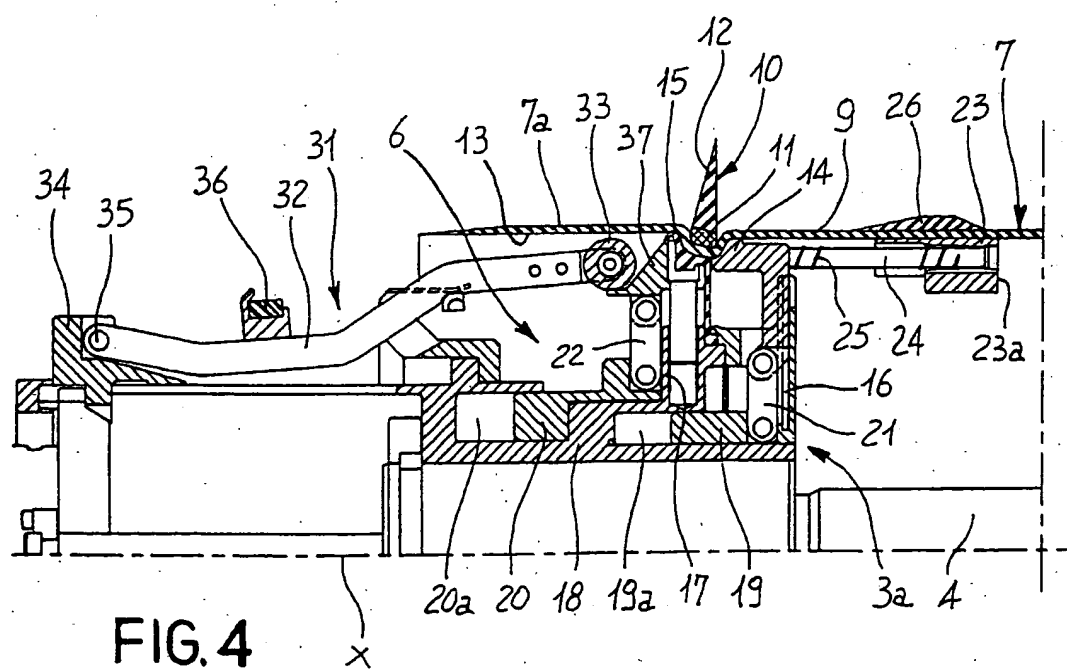
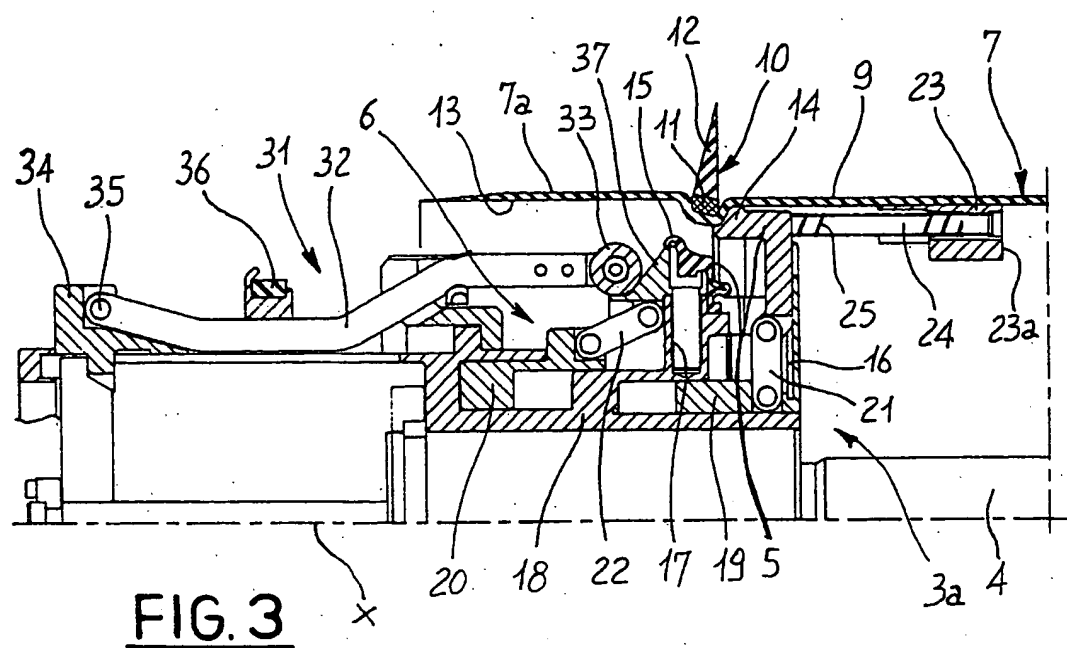
19. Apparatus as claimed in claim 16, wherein each turning-up device (31) comprises at least one elastic element (36) extending around the geometric axis (X) of the drum (2) and operating on said turning-up levers (32) to transmit to the latter a radial-thrust action towards the geometric axis (X) of the drum itself.

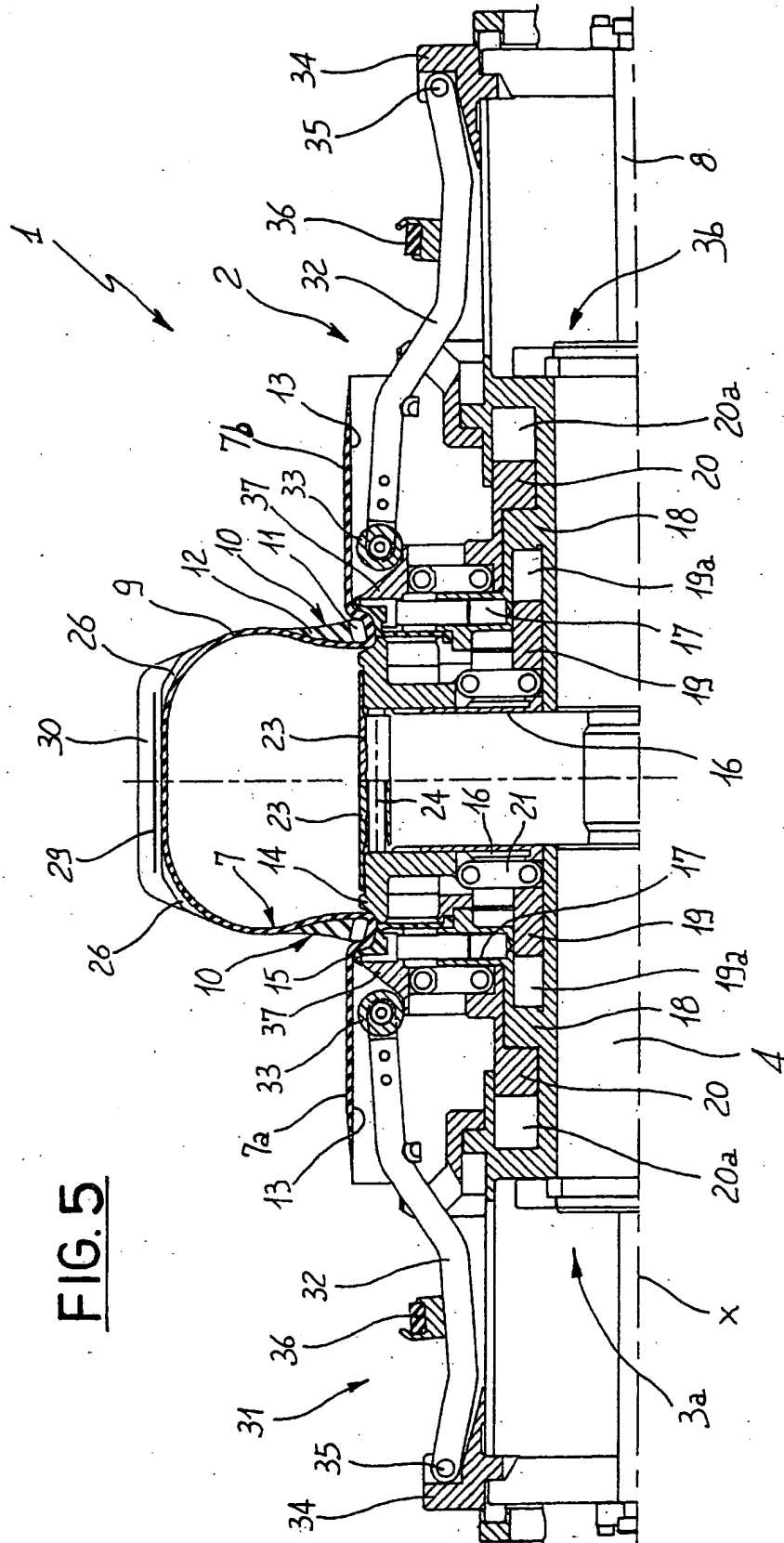
**FIG.1**



**FIG.2**









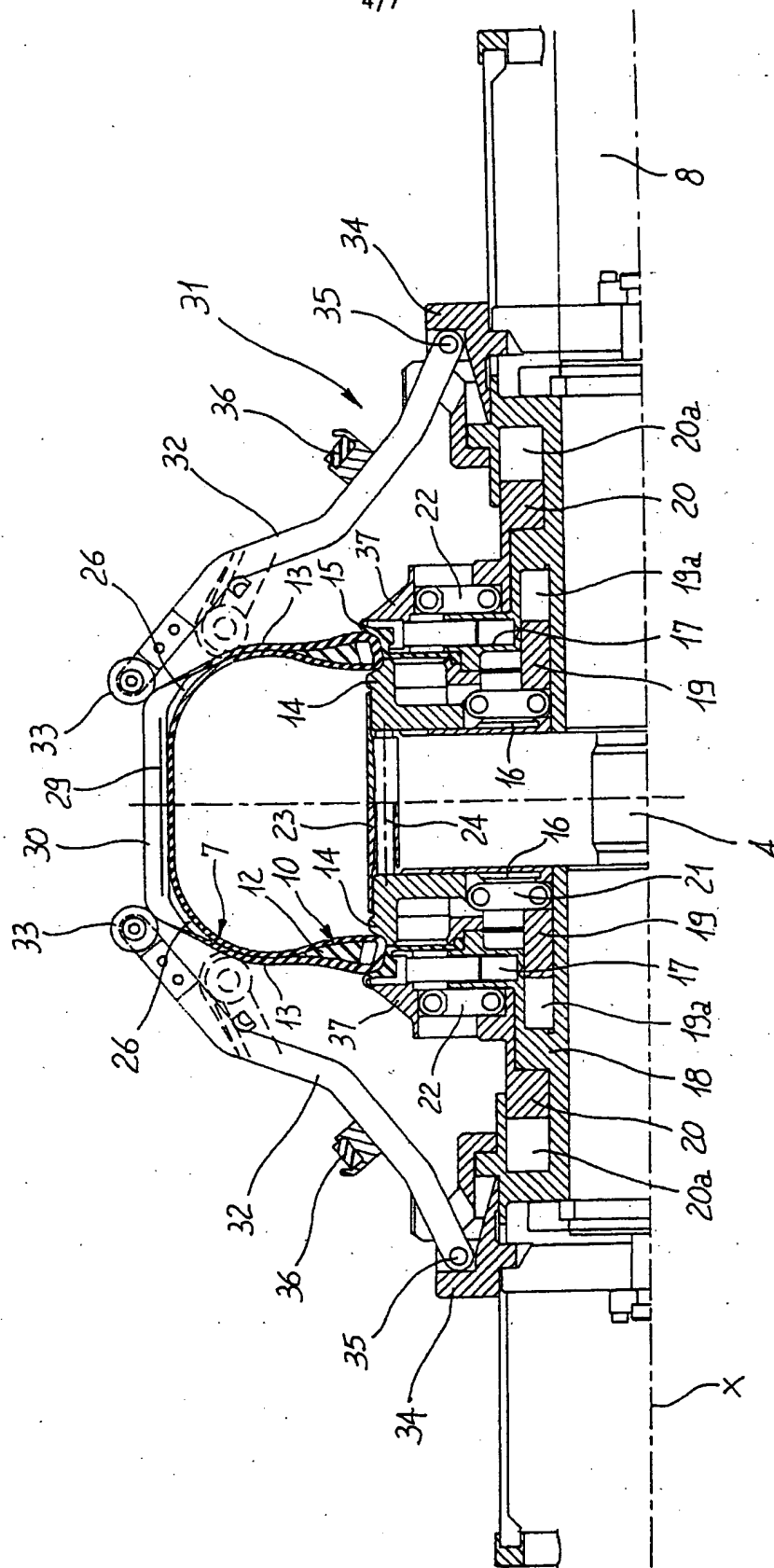


FIG. 6

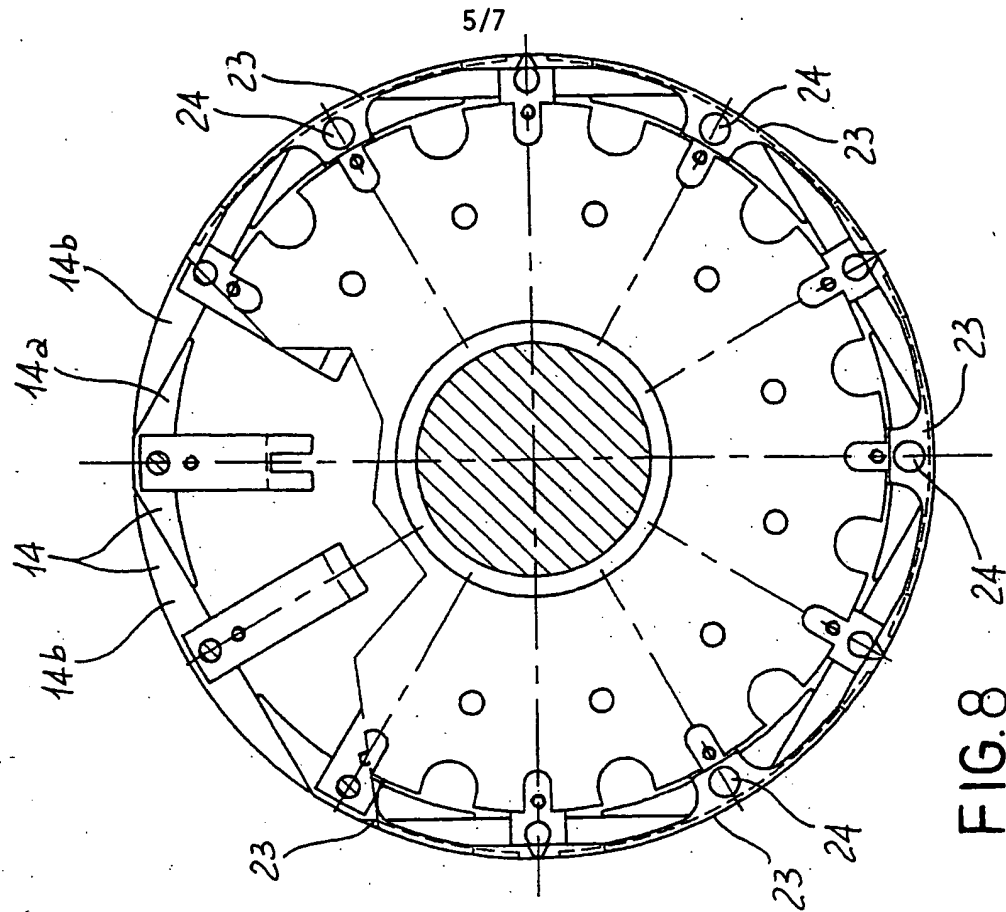


FIG. 8

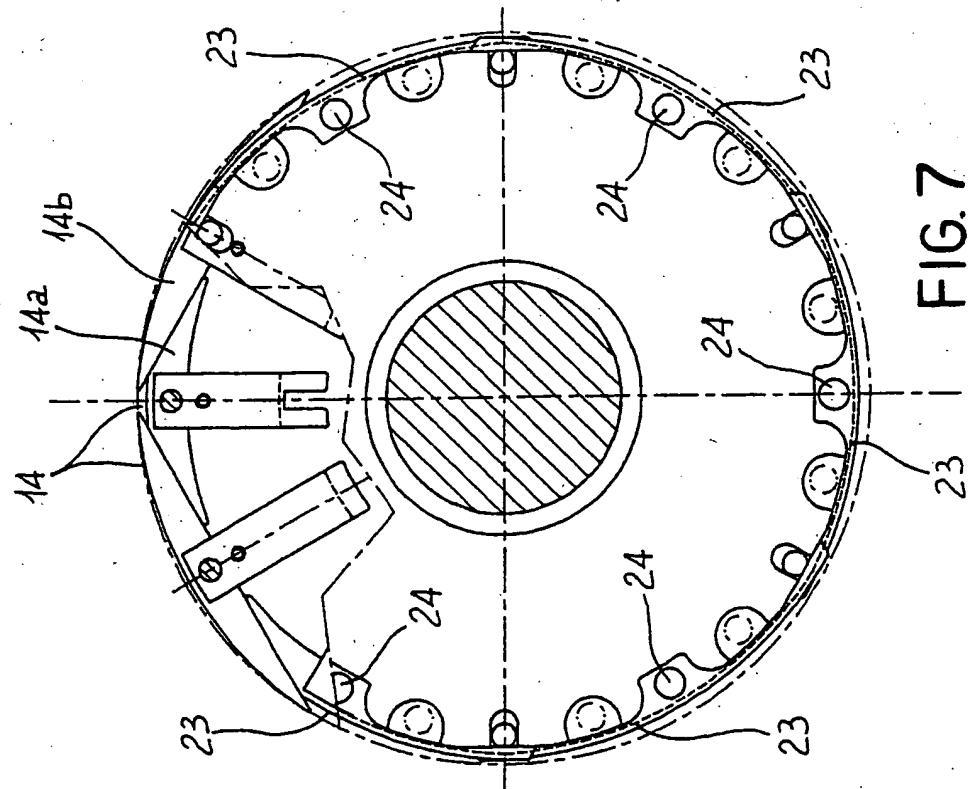
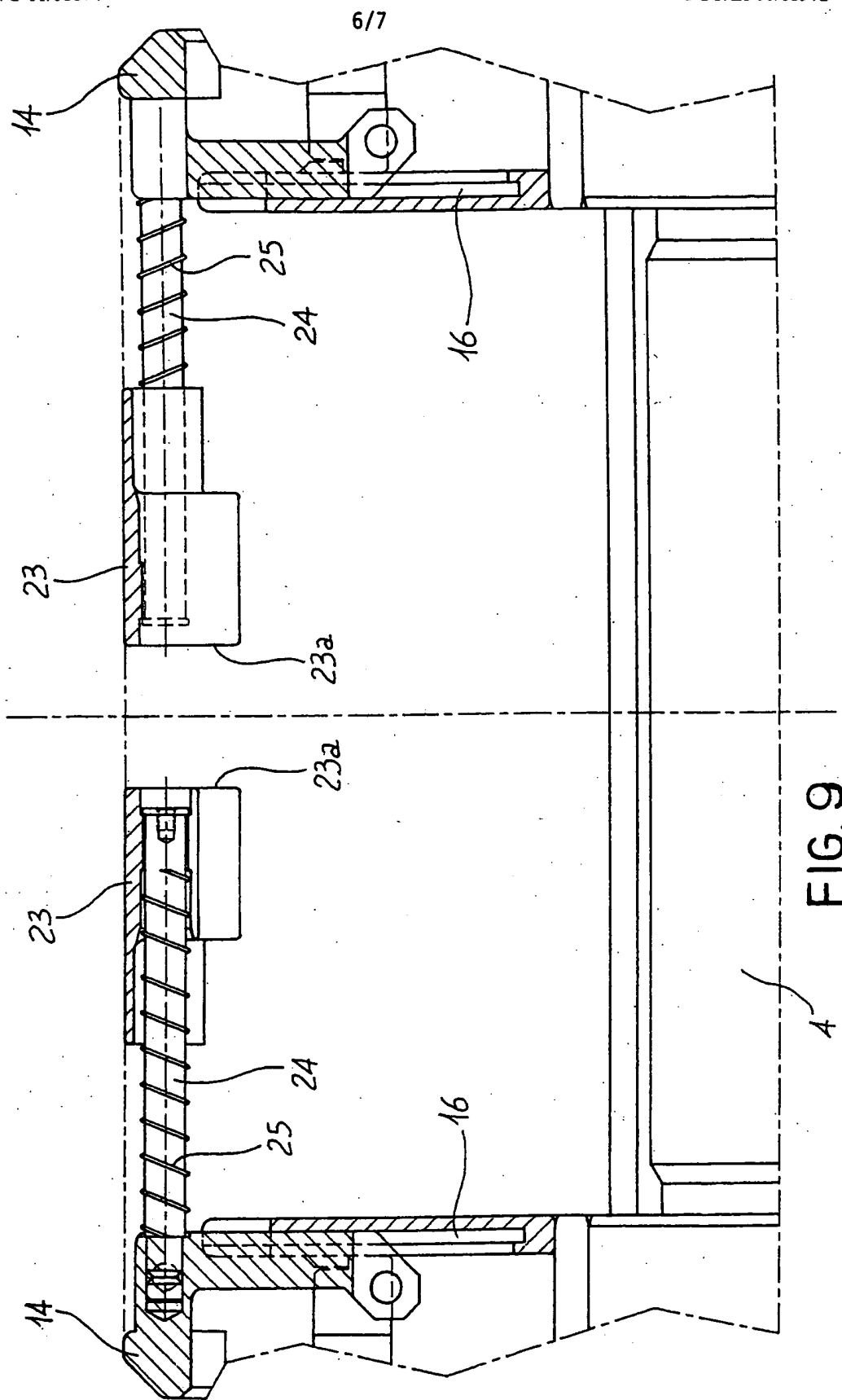
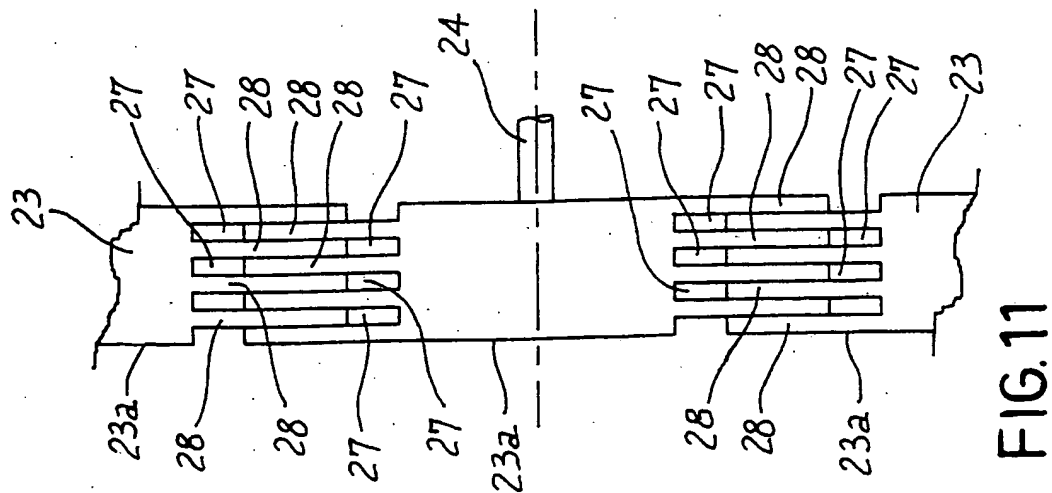
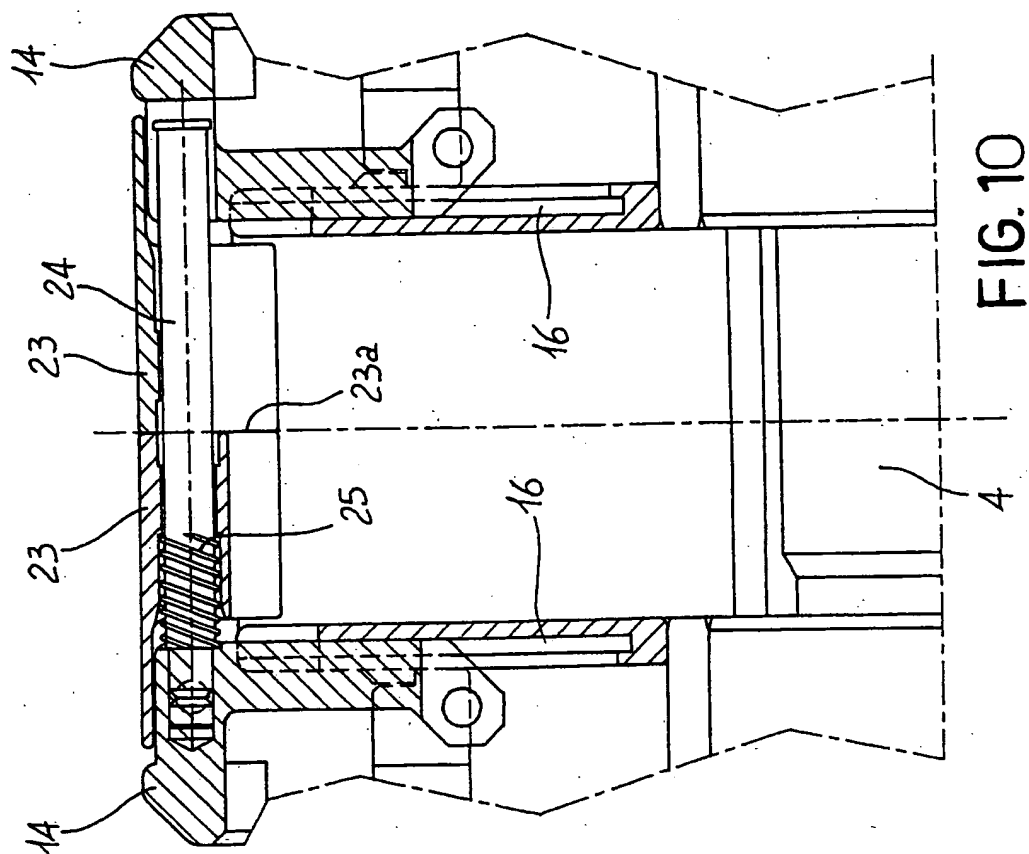


FIG. 7





# INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 00/05972

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B29D30/24 B29D30/32

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B29D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 372 693 A (METZELER KAUSCHUK) 30 June 1978 (1978-06-30) page 4, line 29 - line 38; figures 1,2 page 5, line 35 -page 6, line 29; figures 5-10 ---	1-5, 9, 15
X	EP 0 468 580 A (VMI EPE HOLLAND) 29 January 1992 (1992-01-29) column 6, line 48 -column 7, line 53; figures 1-3 ---	1, 4, 9, 12, 15
X	LU 63 107 A (G. GAZUIT) 31 August 1971 (1971-08-31) page 3, line 4 - line 21; figure 1 ---	1, 9, 12, 15
	-/--	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

27 October 2000

Date of mailing of the international search report

06/11/2000

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# INTERNATIONAL SEARCH REPORT

Intern. Application No

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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